

An anatomical illustration of the human circulatory system. A semi-transparent human torso is shown, revealing the heart and the network of arteries and veins. The heart is centrally located, with red arteries branching out to the left and right sides of the body, and blue veins returning blood to the heart. The background is a deep red, filled with numerous red blood cells of varying sizes, some in sharp focus and others blurred, creating a sense of depth and movement. The overall color palette is dominated by reds and blues, emphasizing the blood and the vascular system.

# The Circulatory System

## SBI 3U



# The Circulatory System

The Circulatory system plays many important roles in the overall function of humans.

The main functions of the circulatory system are:

- ★ **Respiration:** delivers oxygen to cells and removes carbon dioxide
- ★ **Nutrition:** carries nutrients from the digestive system to the cells of the body
- ★ **Waste removal:** disposes of metabolic waste products that can be harmful to the body
- ★ **Immunity:** helps deliver cells that fight against illness and disease
- ★ **Cellular communication:** the blood carries hormones to various parts of the body
- ★ **Thermoregulation:** blood transfers heat around the body



# Types of Circulatory Systems

## Open Circulatory System

- blood leaves the blood vessels and bathes the cells directly
- blood flow is less efficient
- organisms move muscles to move blood back into the vessels

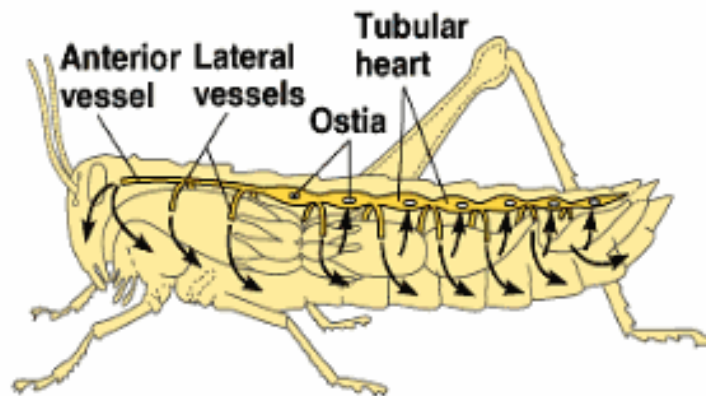
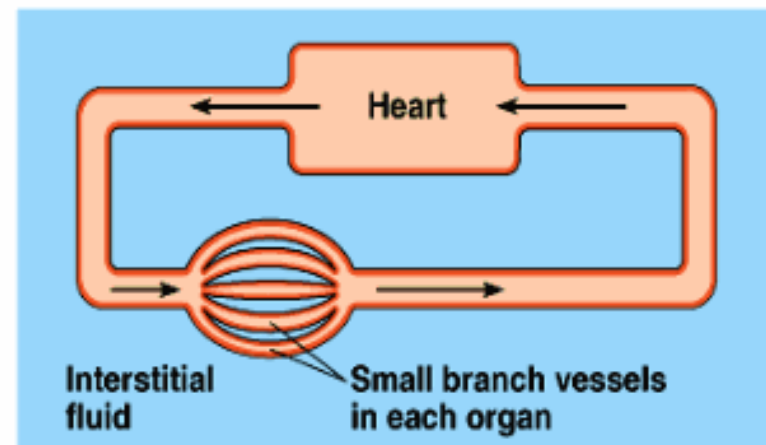
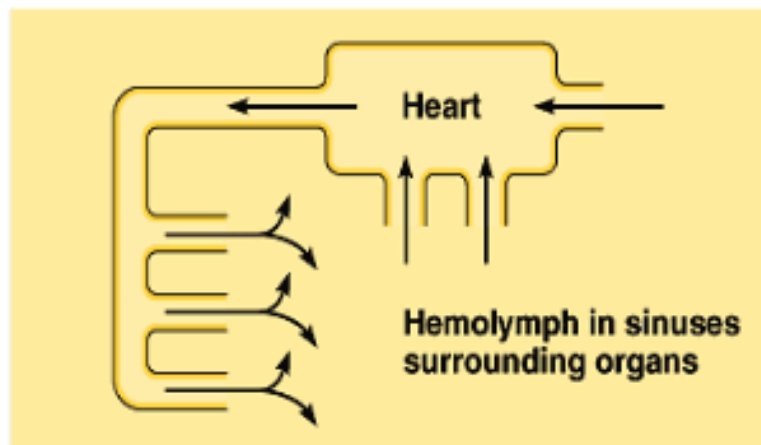
Examples: snails, insects & crustaceans

## Closed Circulatory System

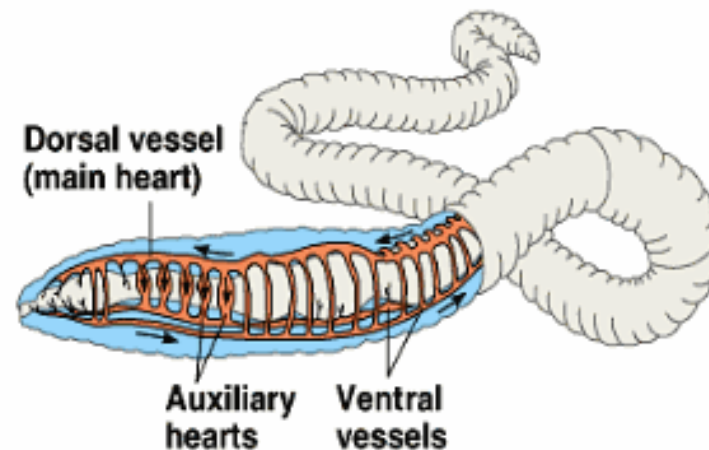
- blood is always contained in vessel
- blood flow is more efficient



# Types of Circulatory Systems



(a) Open circulatory system



(b) Closed circulatory system



# The Circulatory System

## Components of Blood

- Average 70 kg individual has about 5L of blood.
- Approximately 55% of blood is fluid which is referred to as **plasma** (90% water).
- Remain 45% is composed of blood cells.
- The plasma also contains blood proteins, glucose, vitamins, minerals, dissolved gases, and waste products.
- The large plasma proteins help maintain homeostasis.
  - **Albumins** – establish an osmotic pressure and draws water back into capillaries and helps maintain body fluid levels.
  - **Globulins** – protects against invading microbes.
  - **Fibrinogens** – important in blood clotting.



# Types of Circulatory Systems

## Erythrocytes

- Red blood cells that contain hemoglobin
- Estimated 280 million hemoglobin molecules in a single red blood cell.
- Primary function is the transport of oxygen
- Hemoglobin – increase the ability for blood to carry oxygen by a factor of almost 70.
- Cells deprived of oxygen for longer than 5 min start to die.
  - People survive heart stopping for a short period of time
  - Immersed in cold water – slow metabolism and decrease oxygen demand.



# Types of Circulatory Systems

## Red Blood Cells

- Biconcave (concave on both sides)
- Shape provides greater surface area for gas exchange
- Outer membrane become brittle with age, which cause them to rupture as they file through narrow capillaries.
- Red blood cells live only about 120 days.
- At least five million red blood cells are produced every minute of the day.
- Do not contain a nucleus when mature (more room for hemoglobin).
- Produced in the bone marrow by nucleated stem cells and lose their nuclei as they are discharged into the blood stream.
- Anemia – deficiency in hemoglobin or red blood cells



# Types of Circulatory Systems

## Leukocytes (white blood cells)

- Less numerous than red blood cells.
- Red to white 700 to 1.
- Have nucleus.
- Produced in the bone marrow.
- Two types of white blood cells
  1. Granulocytes
  2. Agranulocytes – modified in the lymph nodes
- Some leukocytes destroy invading microbes by phagocytosis while others white blood cells form special proteins called **antibodies**, which interfere with invading microbes and toxins.





# Types of Circulatory Systems

## Platelets

- Responsible for blood clotting.
- Like red blood cells, do not have a nucleus
- Produced in the bone marrow, small fragments of cytoplasm break from megakaryocyte, a large cell in the bone marrow, to form platelets.
- irregularly shaped platelets move through the smooth blood vessels of the body but rupture if they strike a sharp edge, such as a torn blood vessel.
- This is how the fragile platelets initiate blood-clotting reactions